

Tieton Dam
South and East of State Highway 12
Naches Vicinity
Yakima County
Washington

HAER No. WA-20

HAER
WASH,
39-NACH.V,
2-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Western Region
Department of Interior
San Francisco, California 94102

HISTORIC AMERICAN ENGINEERING RECORD

HAER
WASH,
39-NACH.
2-

Tieton Dam

HAER No. WA-20

Location: 22-1/2 miles above confluence with Naches River, south and east of State Highway 12, 40 miles northwest of Yakima, 27 miles west of the city of Naches, Yakima County, Washington

UTM: Zone 10 A - E 643400; N516 8820
B - E 643460; N516 8420
C - E 643140; N516 8420
D - E 643260; N516 8800

Quad: Rimrock Lake, Section 31, Township 14N, Range 14E

Date of Construction: 1917-1925

Engineer: Frank Weymouth, Chief Engineer

Builder: Frank Crowe, Construction Engineer, Bureau of Reclamation, USDI

Present Owner: Pacific Northwest Regional Office
Bureau of Reclamation
U.S. Department of the Interior
Boise, Idaho

Present Use: Irrigation Water Storage

Significance: At the time of its completion in 1925, the Tieton Dam was the highest earthfill dam in the world. "Two of the foremost engineers in Western water development, Frank Crowe and Frank Weymouth, were involved in its construction" [CH2M Hill 1984: 17]. Several innovative construction methods involving the use of tunnels and shafts were applied to excavate the core wall, for deep excavations And unconsolidated rock surfaces made open trenching an impossibility. An important unit of the Bureau of Reclamation's Yakima Project, the Tieton Division is a series of storage dams, including the Tieton Dam, and complex conveyance systems that opened large areas of dry shrubland to irrigation and permanent settlement. The success of this project spurred development of irrigated agriculture throughout central and eastern Washington. The Tieton Dam was determined to be eligible for listing in the National Register of Historic Places in 1983.

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Date: January 1988

INTRODUCTION

The Bureau of Reclamation is proposing modifications to Tieton Dam, a property determined eligible for listing on the National Register of Historic Places, for safety, maintenance and operational reasons. The Bureau of Reclamation (BOR) plans to replace the original 24-inch and two 60-inch needle valves, which control the outlet works and are embedded in the outer concrete wall of the valve house, with two 60-inch jet flow gates. Other proposed modifications to the valve house include a new roof, the filling in of the windows with concrete, replacement of the ceiling crane with a 25-ton capacity type, and removal of obsolete needle valve control mechanisms. The floor of the valve house will be partially removed to allow the old valves to be taken out and the new jet flow gates to be installed.

In addition to the needle valve replacement, BOR proposes to build a 400-foot footbridge above the six spillway gates and to install safety ladders on the piers between the gates. The footbridge design and coloration will be compatible with the existing features.

Other modifications to the dam include the replacement of the outlet tunnel's wooden portal wall and door, and energy and mechanical renovations to the upper gatehouse (remote control house) which includes the replacement of the roof with the same type to be installed on the valve house.

After consideration of the above undertaking, BOR concluded that the effects will be "adverse" as defined in Section 106 of the National Historic Preservation Act of 1966 (P.L. 86-665, as amended), which requires all Federal agencies to take into account the effects of their undertakings on properties listed in, or eligible for listing in, the National Register of Historic Places, and afford the Advisory Council on Historic Preservation an opportunity to comment. As required by Section 106, BOR entered into a "commenting" or consultation process with the Advisory Council on Historic Preservation and the State Historic Preservation Officer to negotiate a Memorandum of Agreement (MOA) on means to avoid or mitigate the adverse effects of the undertaking.

This Historic American Engineering Record (HAER) narrative report, and the photographic documentation done by BOR, are stipulations of the MOA between BOR, the State Historic Preservation Officer, and the Advisory Council. The MOA requires that BOR mitigate the adverse effects of the project by documenting the existing structures to HAER standards.

HISTORICAL BACKGROUND - Tieton Division, Yakima Project

Early attempts at irrigation in the Yakima Valley began soon after the arrival of the first white settlers in the 1860s. They were attracted by the valley's abundance of bunch grass, wild game and fertile bottomlands. The first irrigation ditches were reported in 1864, although at that time the ditches were several years old and had probably been built by local Indians under the guidance of missionaries. Soon thereafter, private canal companies located along the Yakima River. The arrival of the Northern Pacific Railroad in 1886 further stimulated irrigation development. In 1890, an irrigation district law was enacted by the Washington State Legislature which led to the

formation of the Wide Hollow and Cowiche Irrigation Districts in eastern Washington. A year later, there was an examination of the Tieton canyon as a source of water supply for irrigation of the Yakima basin.

The first significant private irrigate concern in the Yakima basin was the Washington Irrigation Company, a subsidiary of the Northern Pacific Railway. The company's irrigation facilities, covering over 40,000 acres, were acquired by the U.S. Government at the turn of the century and put under the administrative control of BOR. BOR sought to integrate the Sunnyside Canal of the Washington Irrigation Company into a comprehensive system, extending from the mountain lakes in the Cascades to the Yakima and Tieton basins [Coulter, 1958].

The passage of the Reclamation Act of 1902, creating BOR, and a petition in 1903 from the citizens of Yakima County to the Secretary of the Interior, requesting comprehensive irrigation development, led to the establishment of the BOR's Yakima Project in 1905, the largest irrigation project in the country to that date.

The Yakima Project's Tieton Division was one of the first irrigation projects in the West to be investigated and constructed under the Reclamation Act of 1902. The BOR established an office in Yakima in 1906 and work began the following year on the Tieton Division. The Tieton Water Users Association was organized to contract with BOR for the construction and operation of the Tieton Division irrigation works. Concurrently, there were survey investigations of storage reservoir sites at Bumping Cle Elum, Kachess, and Keechelus Lakes, and McAllister Meadows. Formerly the site of the Russell Ranch homestead, McAllister Meadows was acquired by BOR for the site of Tieton Dam and Rimrock Reservoir. When completed, the Tieton Division consisted of the Tieton Canal and Diversion Dam, Tieton Dam and Rimrock Reservoir, Bumping Lake Dam and reservoir, and the Clear Creek Dam and reservoir.

The first irrigation waters from the Tieton Division became available in 1909 with completion of the 12-mile Tieton Canal, the first canal built in the entire system of the Yakima Project. A reinforced concrete flume with a circular cross-section, the canal was considered a major and innovative engineering challenge, due to its isolated, rugged location that required five tunnels that totalled almost two miles in length, driven through solid rock [Hiler, 1981].

Irrigation water for the lands in the Tieton Division is diverted by the Tieton Diversion Dam into the Tieton Canal. From the canal, the water is delivered into the north fork of Cowiche Creek and diverted at various points by diversion dams into eight main laterals, and to the lands designated for irrigation.

The Yakima Project receives its water supply from the Yakima River and its tributaries. The six reservoirs at the head of these waterways have a total storage capacity of 1,070,700 acre-feet. "The Yakima Project provides irrigation water for a comparatively narrow strip of fertile land that extends for 175 miles on both sides of the Yakima River in south-central Washington. The irrigable lands presently being served total about 465,000 acres. Besides Tieton, there are six other

divisions in the project: Storage, Kittitas, Sunnyside, Roza, Kennewick and Wapato... Storage dams and reservoirs on the project are Bumping Lake, Clear Creek, Cle Elum, Kachess, Keechelus, and Tieton. Other project features are five diversion dams, 420 miles of canal, 167 miles of laterals, 30 pumping plants, 144 miles of drains, two power plants, and 73 miles of transmission lines... The Tieton Division includes 27,271 acres of land lying west of the city of Yakima between the Naches River and Ahtanum Creek" [USDI, 1983:1]

The Yakima Project's Tieton Division brought 24,000 acres of land into gravity irrigation. "The demonstrated productivity of orchard lands irrigated in the Tieton Unit substantiated the land sales promotions and investments underway from 1906-1911" [CH2M Hill - D.O.E., 1983: N.P.], which led to substantial increases in population in the Yakima valley. An immediate success, the Tieton Division, as well as the entire Yakima Project, stimulated the development of irrigated agriculture and permanent settlement throughout the central and eastern parts of the state. Irrigation provided by the Tieton Division turned Yakima County into one of the leading agricultural centers in the country.

While built and owned by BOR, the Tieton Division is operated by the Yakima-Tieton Irrigation District (Y.T.I.D.). With more than 30,000 acres currently under irrigation in the Tieton Division, the constructions of \$95.00 per acre was among the highest of the early BOR projects. In 1947, however, the Y.T.I.D. became the first Federal reclamation project district to fully complete repayments of construction costs to BOR.

CONSTRUCTION OF THE TIETON DAM

Early History:

Construction of the Tieton Dam can be divided into three periods: pre-1917, 1917-1921, and 1921-1925. Two of the foremost engineers in Western water development were in charge of building the Tieton Dam: Frank Crowe, Tieton construction engineer and innovative BOR dam builder, who became construction superintendent for the Hoover Dam project; and Frank Weymouth, chief engineer at Tieton, who became chief engineer for BOR.

The decade prior to 1917 was a period of survey and exploration of the reservoir and dam site. Initially, 21 miles of wagon road had to be reconstructed along the Tieton Canyon to connect the work camp with the main highway near Naches. Actual work was begun on the dam site in 1917. Camp shops and plants were established, and work on the diversion tunnel begun. All work, however, was suspended in 1918 due to America's entry into World War I. Work was resumed in 1921 with the clearing and stripping of the dam site, and excavation for the core wall. The reservoir site was heavily timbered and required the clearing of 2,700 acres.

The Tieton Dam was built by BOR personnel, with small contracts let for hauling, clearing and cutting the dam and reservoir site. As construction intensified, the camp grew from a scattering of tent sites to 12 two-story bunkhouses that accommodated over 470 men. "The camp, however,

was largely a family camp, consisting of 112 houses. The largest force employed was 570 men..." [Rowe, 1938:99]. The dam was completed in 1925.

Physical Description:

The Tieton Dam and Rimrock Reservoir are located in a steep canyon carved by the Tieton River, a glaciated valley cut into tertiary and older volcanic and sedimentary rocks. Elevations in the area range from 2,935 feet at the reservoir surface to 5,700 feet along the Russell Ridge north of the impoundment. The dam's foundation consists of glacial till, shale, and volcanic rock.

The four main features of the dam are the embankment, the core wall, the outlet works and the spillway. When completed in 1925, the Tieton Dam was the highest earthfill in the world. The earth, gravel and rockfill embankment, placed by semi-hydraulic fill methods, has a concrete core wall diaphragm extending from bedrock (100 feet below the riverbed) to the dam's crest and anchored in solid rock on both abutments. The height from the deepest core wall foundation to the crest is 320 feet, while the hydraulic height measures 198 feet. The length along the crest is 920 feet. The dam's crest elevation is 2935.0 feet, a top width of 40 feet, and a maximum base width of 1,100 feet. The total yardage in the embankment is 1,995,000 cubic yards, of which 1,570,000 cubic yards are earth and gravel and the remainder is rock.

"The embankment was placed by dumping material at the outer slopes and hydraulically washing the fines to the center against the concrete core wall. On the upstream side of the core wall, a pool was maintained to settle out the fine material, forming the clay puddle core in front of the core wall" [USDI, 1985:21]. The earth, gravel and boulders were excavated by steam and electric shovels from borrow pits, loaded on dump cars, and hauled to trestles on the upper embankment slope where the material was sluiced up against the core wall by large water jets. This method graded and compacted the embankment, pushing sand and silt against the core wall, leaving the coarser gravel and cobbles near the outer faces. The lower slope of the dam embankment is, thus, covered with a heavy rock layer, especially the downstream slope where rockfill was loosely dumped. On the upstream side, portions of the riprap were hand-placed near the top where considerable settlement has occurred over the years.

The construction of the core wall presented a number of unique engineering challenges. Several innovative construction methods involving the use of tunnels with shafts were applied to excavate the core wall. "The deep excavations, 95 feet below the riverbed to suitable foundation, and loose overlying materials, made open trenching an impossibility. Instead, the stoping method of excavation was used. Shafts were sunk to the full depth, then cross tunnels six feet high and five feet wide were cut between the shafts... Waste material was then moved to the surface through the shafts and dumped. When the second tunnel was finished, the first was concreted and work commenced on the third tunnel. This process was repeated until the ground surface was reached. The finished concrete core wall was five feet thick below the surface with no reinforcing. It tapered to one foot thick at the top, where it was extensively reinforced. The entire concrete core wall was 319 feet high and was tied into the canyon walls with a five-foot-deep key trench" [CH2M Hill - D.O.E., 1983: n.p.].

The outlet works consist of a concrete intake tower, a tunnel through the left abutment joined by an inclined auxiliary intake, an emergency gate chamber in the tunnel, two emergency gates, two outlet pipes, and three balanced needle valves. The outlet works is located under the left side of the reservoir and through the left abutment of the dam. The main (downstream) portion of the 2,120-foot outlet tunnel is unlined and contains two 72-inch diameter steel conduits, each about 700 feet long, that terminate at a 60-inch balanced needle valve (in the valve house) used to regulate the discharge from Rimrock Lake. Two 60-inch and one 24-inch hydraulically-balanced needle valves are embedded in the outer walls of the valve house for regulation of releases of water from the reservoir. The left needle valve is designated No. 2 and the right, No. 1. The 24-inch needle valve is installed between the 60-inch valves, with supply branch connections from each 72-inch pipe. The three needle valves are essentially identical in design, with the operation of the valves by means of pressure regulation within the interior of the valve body. "The 60-inch balanced needle valves have a total discharge of 100 ft³/s" [USDI, 1984:2-1]. The emergency slide gates discharge water into the two 72-inch welded steel outlet pipes that terminate in the two 60-inch and one 24-inch balanced needle valves. The gates are provided with two independent sets of controls, one in the gate chamber immediately above the gates and the other in the gatehouse on top of the dam.

At the west end of the dam, in the left abutment, is a gated spillway that consists of a side overflow movable crest at a right angle to the dam and a 1,350 foot, trapezoidal concrete-lined channel that discharges into a stilling basin below the dam. The side-channel weir is controlled by six 65' x 8' drum gates, with a normal discharge capacity of 30,000 cubic feet of water per second. The crest elevation of the spillway, varying from elevations of 2,918 to 2,926 feet, is determined by the position of the drum gates. The effective crest length is 390 feet [USDI, 1985]. All of the gates operate manually, as the automatic controls on the first two drum gates are no longer functioning.

The construction of the dam created Rimrock Lake, a nine-mile reservoir with a storage capacity of 198,000 acre-feet (at normal water surface elevation) that supplies about 20% of the storage water for the Yakima Project. The surface area of the reservoir is approximately 2,500 acres at a water surface elevation of 2,926 feet. The reservoir's total drainage area covers 187 square miles.

A spalled concrete parapet wall with decorative concrete-base lamp posts runs the entire crest of the dam. The wall, with exposed reinforcing, is in poor condition, and the lamp posts are in desperate need of repair. With their original glass globes and bulbs missing, the lamp posts are no longer operative, and are scheduled to be removed when the parapet wall is repaired or removed.

A square, concrete-block remote control house (Upper Gatehouse) is also located on the crest of the dam.

EXISTING CONDITION

The following is descriptive information of structures to be affected by the proposed dam modifications:

Valve House

Located on the downstream side and left abutment of the dam's embankment is a rectangular, concrete-block valve house. The building has retained much of its original appearance except for the windows and roofing. The original galvanized sheet metal roof formed to simulate Spanish tile was replaced in the late 1930s by the current corrugated galvanized metal sheeting and metal cornice [USDI - S.O.W., 1987]. The current roof will be replaced by a standing seam metal roof that will have a brick red finish to match the original color as near as possible. The present hip roof design and the steel truss/woodplank ceiling will be retained.

A new roof is required because the stronger standing seam type is constructed for easy removal, necessary during maintenance of the jet flow gates that will replace the original outlet needle valves embedded in the outer concrete wall of the valve house. The main floor of the valve house will be partially removed during the removal of the needle valves and installation of the jet flow gates. The main floor, which has mainly been used for storage, was not an original design element. The original design was open and the large windows on the ground floor were the main source of day-time light for the valve house. The ceiling crane above the main floor will be replaced by a new 25-ton capacity traveling crane that will assist the installation and removal of the taller jet flow gates [USDI - S.O.W. 1987].

The replacement of the one 24-inch and two 60-inch needle valves, which control the outlet works, with two 60-inch jet flow gates will necessitate the removal of obsolete needle valve control operating mechanisms. The 30-inch guard gates and controls, including piping between the gates and the 24-inch needle valve will be removed and blind flanges installed in place of the 30-inch guard gate. "All structural voids remaining after the removal of the valves and other associated equipment and installation of the jet flow gates, will be filled with concrete..." [USDI - S.O.W., 1987:4]. Equipment to be removed includes the Dean Operating Control Systems for the needle valves. The needle valves were built by the Kennedy Valve Manufacturing Company of New York. The control valve piping between the outlet pipes and needle valves was manufactured by the Armstrong Machine Works of Three Rivers, Michigan. The piping directly into the needle valves was manufactured by the Jenkins Brothers Company.

The valve house's multi-pane, fixed-sash windows are currently covered with plywood. The windows, however, will be filled in with concrete for security reasons. "Concreting the openings on the same plane as the windows will maintain the existing 4-inch recess into the wall, thus not disrupting the basic architectural lines" [USDI - S.O.W., 1987:4].

Finally, the existing gantry crane located outside the valve house and the "Tieton Dam 1925 inscribed into the front facade will both be retained. The original decorative globe lights on the building's front facade are no longer intact.

Spillway

At the west end of the dam, in the left abutment, is the gated spillway. BOR "proposes to build a 400-foot footbridge above the six spillway drum gates and install safety ladders on the piers between the gates" [USDI - S.O.W., 1987:4]. The footbridge and ladders "are required to allow maintenance during spills and to negate the need to build temporary structures during periodic overhauls. The bridge will be a utilitarian metal structure that is in keeping with spillway design" [USDI - S.O.W., 1987:5]. A permanent manhole will also be installed on the top of each drum gate to improve ventilation and access.

Outlet Tunnel Portal

The exterior wooden outlet tunnel portal wall and door, located behind the valve house, will be replaced. The original wooden door and wall are in place approximately three feet behind the current ones, but are in very poor condition. The original wall consists of horizontal planks. The original door is a multi-pane, fixed sash, double (leaf) swinging type. The exterior wall and door will be replaced with either a concrete wall and a metal door or an all-metal wall and door, to improve security.

Upper Gatehouse (Remote Control House)

Situated on the crest of the dam is a square plan, concrete-block gatehouse. The building has retained much of its original appearance, except for the windows. The original multi-paned, fixed-sash windows on the side facade have been removed and filled in with concrete.

The simulated, Spanish tile hip roof (made of galvanized metal) and the metal cornice will be replaced with the same type of roof that will be installed on the valve house.

The gatehouse controls the emergency slide gates that are located directly below the gate chamber in the outlet tunnel. A gasoline engine in the gatehouse serves as a back-up to the main electrical system that powers the pumps in the gate chamber to operate the slide gates. While this process will not be affected by proposed dam modifications, other aspects of the building will be changed.

There will be energy and mechanical renovations to the gatehouse. The existing single panel, double metal door will be replaced by a standard-width, insulated single type. The existing multi-pane, fixed-sash glazed window will be replaced with a smaller double-pane insulated window. The resulting gaps around the door and window will be filled with concrete. Also, the existing dropped wooden ceiling which covers the original horizontal plank ceiling will be replaced and the original ceiling insulated [USDI - Memorandum, 1987].

Finally, the original decorative globe lights on the building's front facade are no longer intact.

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